# Portsmouth & Oak Ridge Vendor Forum on Bioremediation and Delivery Systems

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## PROCEEDINGS

Oak Ridge, Tennessee
November 5-6, 2000

*Prepared by*
**The TechCon Program**

SUBSURFACE CONTAMINANTS FOCUS AREA

# Acknowledgements

The success of the Portsmouth and Oak Ridge Vendor Forum on Bioremediation and Delivery Systems was due to the efforts of all who organized and participated. Department of Energy and Bechtel Jacobs project teams from both sites were proactive hosts.

The Subsurface Contaminants Focus Area's TechCon Program organized and facilitated the forum. Considerable effort went into identifying qualified and experienced commercial vendors to participate in the forum. TechCon also provided a platform where project teams could meet with commercial vendors individually or as a group to discuss remediation of contaminated groundwater. The ITRD Program facilitated pre- and post-forum meetings with the project teams. Participation of representatives from the INEEL ASTD project provided insight into bioremediation. Commercial vendors shared project experiences and provided the foundation for a high level of confidence for successful bioremediation at Portsmouth.

The ultimate confirmation of the forum's success will be the deployment of bioremediation and associated delivery system technologies during fiscal years 2001 and 2002 at the Portsmouth and Oak Ridge sites.

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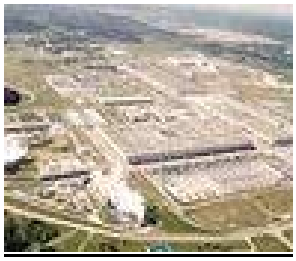


# Executive Summary

***Portsmouth has recently identified bioremediation as a remedial alternative for treating groundwater.***

***At Oak Ridge Y-12, bioremediation has also been identified as a remedial alternative for treatment of groundwater.***

***TechCon identified commercial vendors experienced in bioremediation and delivery systems in preparation for upcoming Request for Proposals.***

The U.S. Department of Energy (DOE) Oak Ridge Operations is currently targeting the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio and the Y-12 Plant in Oak Ridge, Tennessee, for deployment of bioremediation technologies to treat groundwater contaminated with chlorinated solvents. Pilot-scale bioremediation is anticipated at Portsmouth in FY 2001, and Oak Ridge Y-12 in FY 2002.

Portsmouth has recently identified bioremediation as a remedial alternative for treating groundwater at one of the Solid Waste Management Units. The X-749/X-120 Area in Quadrant I contains a contaminant plume consisting primarily of TCE. The two sources of groundwater contamination that formerly existed in Quadrant I were the X-749 landfill and the site of the defunct X-120 Goodyear Training Facility. Although the X-749 and X-120 areas are no longer sources of contamination, the groundwater contains levels of TCE above the targeted risk level of $1 \times 10^{-6}$. The Portsmouth DOE and Bechtel Jacobs project teams have also identified the need to evaluate delivery systems approaches to support the bioremediation effort.

At the Oak Ridge Y-12 Plant bioremediation has also been identified as a remedial alternative for treating groundwater in the Upper East Fork Poplar Creek watershed. This groundwater contains $CCl_4$ in quantities greater than permitted by Environmental Protection Agency regulations for drinking-water sources. The source of $CCl_4$ is considered to originate from the DNAPL contained in the fractured bedrock underlying an area of the Y-12 Plant.

The Subsurface Contaminants Focus Area's TechCon Program and Innovative Treatment Remediation Demonstration, in conjunction with the INEEL Accelerated Site Technology Deployment project, responded to requests from Portsmouth and Oak Ridge for technical assistance. As part of the technical assistance approach taken by TechCon, commercial vendors experienced in bioremediation and associated delivery systems were identified in preparation for an upcoming Request for Proposals (RFP).

Using information gathered by TechCon, a Vendor Forum was conducted in Oak Ridge, Tennessee, December 5-6, 2000. Participating vendors were required to submit their capabilities and

relevant project experience to the TechCon web site. Representatives from both project teams described groundwater contamination at the sites. The forum identified immediate opportunities for deploying bioremediation strategies at Portsmouth during FY 2001 and future opportunities at Oak Ridge Y-12 in FY 2002.

***The forum identified immediate opportunities for the deployment of bioremediation strategies at the two sites.***

Of the 26 vendors who submitted their capabilities, 14 were selected to give presentations on the first day. The second day was given to individual interactions among vendors and project team representatives. It provided an opportunity to identify major issues associated with deploying bioremediation at the two sites. It was also an opportunity to resolve many of these issues prior to issuance of the RFP. (These interactions were an essential component of the forum, but the primary purpose was to bring together the site project teams with experienced technology providers.) Discussion of teaming opportunities allowed many vendors to ally themselves with other vendors in preparation of the Portsmouth RFP.

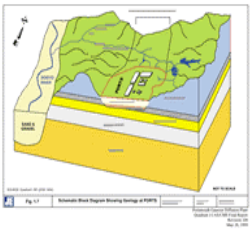
***Of the 26 vendors who submitted their capabilities to the TechCon web site, 14 were selected to give presentations on the first day***.

The current path-forward for Portsmouth is to evaluate the prequalification information submitted by each vendor or team of vendors to the Oak Ridge Bechtel Jacobs Procurement web site. An RFP will be issued in March 2001 with contract award slated for mid-May. The TechCon, ITRD and INEEL ASTD programs will continue providing technical assistance to ensure successful deployments in fiscal years 2001-2002.

***The immediate opportunity for deploying biotreatment is at the Portsmouth site.***

Although both sites will focus on bioremediation as their alternative for treating groundwater, the immediate deployment opportunity is at the Portsmouth site. Therefore, the Vendor Forum (and Proceedings) focused on Portsmouth with references to the Oak Ridge Y-12 site as appropriate.

# SECTION 1



# Portsmouth X-749/X-120 Area TCE Background

The DOE-owned Portsmouth site has operated continuously since January 1955. Its principal process has been the separation of uranium isotopes by gaseous diffusion for $^{235}U$ enrichment. The environmental restoration program at Portsmouth was initiated in 1989.

The investigation, study, and implementation of corrective actions in support of environmental restoration proceeded in a phased approach that divided the facility into quadrants. Quadrant I occupies the southern portion of the Portsmouth reservation. The boundaries of Quadrant I were established with respect to the surface water and groundwater flow and drainage patterns.

***The X-749/X-120 Area in Quadrant I contains a contaminant plume consisting primarily of TCE.***

The X-749/X-120 Area in Quadrant I contains a contaminant plume consisting primarily of TCE. The two sources of groundwater contamination that formerly existed in Quadrant I were the X-749 landfill and the site of the defunct X-120 Goodyear Training Facility. Although the X-749 and X-120 areas are no longer sources of contamination, the groundwater contains levels of TCE that are above the targeted risk level of $1 \times 10^{-6}$.

***One of the primary remedial alternatives combines injection of a compound to enhance bioremediation and planting hybrid poplar trees.***

The X-749 Contaminated Materials Disposal Facility disposed of material contaminated with hazardous constituents and low-level radioactive waste. The northern portion of the landfill received waste contaminated with solvents, oil, and wastewater treatment sludge from 1955 through 1989. The primary contaminant of concern in the groundwater is TCE, believed to have been released during the landfill's operational life. While the primary release pathway to groundwater has been through soils that lie beneath the unit, the X-749 landfill was capped in 1993 to prevent further leaching of contaminants from the vadose zone. The landfill, therefore, is not modeled as a continuing source of groundwater contamination.

The groundwater beneath the X-120 Goodyear Training Facility is contaminated with TCE. While TCE may have been released to groundwater during the operational life of this facility, the area is not modeled as a continuing source of groundwater contamination because soil data for this area indicate TCE is not present at concentrations exceeding the soil leaching value of 48 µg/kg.

One of the primary remedial alternatives consists of injecting a compound to enhance bioremediation and planting hybrid poplar trees in selected portions of the X-749/X-120 Area plume. The Preliminary Remediation Goal for TCE in both the Berea and Gallia groundwater is 5 µg/L.

# SECTION 2

# Technical Assistance

In September 2000, the TechCon Program received a formal request from the Portsmouth DOE and Bechtel Jacobs project teams to provide technical assistance. TechCon was asked to identify bioremediation and delivery system technologies and vendors to treat TCE-contaminated groundwater in a shallow aquifer (30 feet below ground surface) with low hydraulic conductivity ($10^{-6}$ feet per second).

TechCon, familiar with similar bioremediation efforts at Oak Ridge Y-12 and INEEL, included the ITRD Program and representatives from the INEEL ASTD Bioremediation project to provide an integrated approach to technical assistance. TechCon had been working with ITRD on the Y-12 project since 1998, and had enlisted the INEEL representatives to support the Y-12 effort. The collaboration was well suited to support Portsmouth.

TechCon established a project-specific web site, Portsmouth: Biotreatment of TCE in Groundwater, (Appendix A) where the project team, stakeholders, and commercial vendors could exchange information. TechCon initiated a search for commercial vendors with relevant project experience using the TechCon Vendor Contacts Database of nearly 1,000 entries developed and maintained by the TechCon Program. Several other web-based database sources (EPA, DOE, and commercial) were also reviewed. In addition, TechCon emailed its web-site subscriber list (more than 500 subscribers) notifying them of the bioremediation opportunity at Portsmouth.

The initial database search resulted in nearly 100 bioremediation and delivery system candidates. Detailed screening narrowed the field to less than 50 and provided the basis for personal contacts and the solicitation of information through the TechCon web site. Candidates were requested to submit their capabilities and relevant project experience through the Portsmouth project site prior to November 22, 2000 as a requirement for an invitation to the forum.

Each vendor submittal was reviewed and ranked using criteria established by TechCon. Criteria included experience with bioremediation, remediation of chlorinated solvents, DOE, and relevant full-scale deployment. Of the 26 submittals, all but three arrived prior to the deadline.

# SECTION 3


# Web Site Development

TechCon developed the Portsmouth Biotreatment of TCE in Groundwater web site to facilitate collection and dissemination of information. The web site was instrumental in providing project-specific information and updates, collecting data from vendors experienced in bioremediation and delivery system technologies, and qualifying vendors for forum participation. The web site contains specific information applicable to qualified companies interested in biotreatment of TCE-contaminated groundwater in a low hydraulic conductivity aquifer. The web site provides information in the following areas:

***The structure of the web site facilitates collection of relevant information.***

- Project Status
- Project Description
- Technical Resources
- Baseline Considerations
- Participation Information

The web site structure facilitated the collection of vendor data that was assimilated by TechCon and provided to the Technical Advisory Group (TAG) and others. The web site also contains a Project Restricted area where information is accessible only by the TAG.

***An integral part of TechCon's technical assistance is its use of the Internet and project-specific web sites.***

An integral part of TechCon's technical assistance was its use of the Internet and project-specific web sites, such as the email distribution list that allows TechCon to update subscribers (including vendors with updated information). The emails also provided direct links to other relevant web sites.

The Portsmouth Biotreatment of TCE in Groundwater Project web site can be found at
http://web.ead.anl.gov/techcon/projects/Portsmouth

The Oak Ridge, DNAPL in Fractured Bedrock Project web site is
http://web.ead.anl.gov/techcon/projects/dnapl

Access is also available from the TechCon Home web site at
http://web.ead.anl.gov/techcon

# SECTION 4

# The Forum

The Portsmouth and Oak Ridge Vendor Forum on Bioremediation and Delivery Systems was held at the Garden Plaza Hotel in Oak Ridge, Tennessee, December 5-6, 2000. The forum focused primarily on bioremediation and delivery system technologies for treating TCE-contaminated groundwater within Quadrant 1 at the Portsmouth site. The forum was held prior to issuance of an RFP in the second quarter of FY 2001. A secondary focus was the $CCL_4$-contaminated groundwater at the Oak Ridge Y-12 site, since an RFP for bioremediation is anticipated in FY 2002.

More than sixty people participated. Representatives from DOE and Bechtel Jacobs were present (see Appendix B: List of Attendees). Twenty commercial vendors attended; 14 presented their experience with bioremediation and delivery system technologies (see Appendix C: Agenda and Appendix D: Vendor Presentations). Each vendor recommended approaches for treating TCE-contaminated groundwater in a low hydraulic conductivity aquifer at Portsmouth. All presentations are available on the TechCon web site at:

http://web.ead.anl.gov/TechCon/Projects/Portsmouth/resources/index.cfm

The primary goal of the forum was to bring together the end users (site project teams) with experienced technology providers (vendors). The objective was the deployment of one or more technologies to successfully clean-up TCE-contaminated groundwater at Portsmouth beginning in FY 2001. Many secondary goals were achieved that will ultimately contribute to the primary goal:

- Project team education on bioremediation, delivery systems, and their application at Portsmouth
- Vendors given first-hand project information including relevant data and complexity issues
- Opportunity for direct communication between project teams and many bioremediation and delivery system companies in the United States
- The opportunity for project teams and vendors to identify and in some instances resolve issues relative to successful bidding and deployment of bioremediation at Portsmouth
- Sharing information so that technical specifications and the RFP scope of work can be properly prepared; submitted proposals technically and financially structured; contract awarded to the most qualified and economical company or team, and deployment of the most expedient and complete aquifer remediation.

***Many issues relative to the successful application of bioremediation at Portsmouth were identified.***

Important issues relative to the successful application of bioremediation at Portsmouth were identified and in some instances resolved (Appendix E: Key Issues/Resolutions from Facilitated Discussions). These issues included:

- Use of an anaerobic vs. aerobic bioremediation approach
- Ability of bioremediation to achieving cleanup goals/MCLs
- Type of delivery system for supplying nutrients /agents
- Data gaps and informational needs by vendors
- Scope of pilot-scale deployment and size of area
- Length of time to complete pilot-scale test
- Access to additional data and actual aquifer material
- Vendors' experience in low hydraulic conductive aquifers
- Vendors' experience in successful bioremediation of chlorinated solvents
- Impact of bioremediation in conjunction with phytoremediation

***The forum's success was its ability to foster interactions among the participants and raise awareness of the significant opportunities for deploying one or more technologies in FY 2001 and FY 2002.***

The forum's success was its ability to foster interactions among the participants and raise awareness of the significant opportunities for deploying one or more technologies in fiscal years 2001-2002. Vendor interaction often led to teaming arrangements that will lead to more comprehensive prequalification packages submitted to Bechtel Jacobs (Appendix F: Project-Specific Prequalification Criteria).

***The forum provided a platform for interactions that resulted in the identification of key issues and concerns related to the procurement and deployment of bioremediation and delivery system technologies.***

Participants included representatives from the DOE and Bechtel Jacobs Portsmouth and Oak Ridge sites, DOE Site Technology Coordination Group, the Subsurface Contaminants Focus Area, Oak Ridge National Laboratory, and Idaho National Engineering and Environmental Laboratory. The commercial vendors were given an opportunity to interact individually with representatives from Portsmouth, Oak Ridge, Idaho, ITRD, TechCon, and experts in the DOE technical community to discuss treatment strategies and ask questions about the Portsmouth and Oak Ridge projects. The forum provided a platform for interactions that resulted in the identification of key issues and concerns related to the procurement and deployment of bioremediation and delivery system technologies.

# SECTION 5

***The forum was extremely successful in the exchange of technical information between vendors and the project teams.***

***Perhaps the most significant result of the forum was the interaction among vendors that subsequently resulted in many teaming arrangements for the upcoming RFP.***

***A prime example was the unanimous request by vendors for aquifer material so that initial bench-scale treatability studies could be conducted during preparation of their proposals.***

# The Results

The forum was successful in the exchange of technical information between vendors and the project teams. The technical overviews by Bechtel Jacobs for TCE- and $CCL_4$-contaminated groundwater at the Portsmouth and Y-12 sites, respectively, illustrated the problem. Vendor presentations confirmed that biological treatment of groundwater contaminated with chlorinated solvents was successfully applied at many sites and that opportunities for success exist at Portsmouth.

Of major significance was the interaction among vendors that subsequently resulted in teaming arrangements for the upcoming RFP. Many vendors realized that the most pressing issue was not whether bioremediation could treat TCE, but rather the uncertainty associated with the delivery systems for nutrients/agents in an aquifer with a very low hydraulic conductivity. This issue was further compounded by the uncertain dynamics/kinetics of the bioremediation process during pilot-scale deployment.

Another major outcome was the Portsmouth team's realization of the vendor need for specific information, e.g., the unanimous request for aquifer material so that initial bench-scale treatability studies could be conducted when they prepared their proposals. The vendors also requested sample and modeling data so they could model aquifer dynamics and estimate a more accurate time frame to conduct a successful bioremediation pilot-scale test. Other key issues were identified and many were somewhat resolved.

The use of aerobic vs. anaerobic bioremediation was not a major issue. Reductive dechlorination of TCE was considered the preferred method: although aerobic or anaerobic bioremediation could potentially work, aerobic conditions probably prevailed indigenously. Even if aerobic bioremediation did not respond optimally, it would be easier than trying to induce an aerobic environment.

***The issues surrounding the delivery systems were not resolved.***

The issues surrounding the delivery systems were not resolved during the forum; however, many conceptual designs for delivering nutrients/agents to the aquifer were presented, as were the uncertainties associated with each:

- Fracturing offers potential for facilitating lateral distribution of nutrients/agents, but also presents the uncertainty of uniformity and distribution of fractures.
- Horizontal/directional wells may offer a uniform distribution of nutrients/agents as compared to vertical well installation.
- Air and water injections offer two choices for delivering nutrients/agents.
- Natural diffusion kinetics could be enhanced using pressure and/or hydraulic gradients.
- Multiple well injection would assist in a uniform distribution of nutrients/agents but would increase project costs.
- Modeling time and distribution effectiveness for delivery systems is a major uncertainty.

***Delivery system technologies for bioremediation low hydraulic conductivity soils have been successfully applied.***

The following summarizes resolutions to key issues that were derived from forum interactions and information exchanges:

- In-situ bioremediation technologies for treating chlorinated solvents are commercially available and have been deployed successfully on a full-scale basis.
- Anaerobic bioremediation is the preferred method.
- Delivery system technologies for bioremediation of low-hydraulic conductivity soils have been successfully applied under similar conditions on a full-scale basis.

***Preliminary treatability testing with actual aquifer material is necessary to optimize the pilot-scale design for the proposal.***

- Most vendors said they could successfully treat TCE-contaminated groundwater at the Portsmouth site.
- A teaming approach is probably needed for Portsmouth and the forum provided a mechanism for teaming with other vendors to develop integrated approaches.
- Preliminary treatability testing with actual aquifer material is necessary to optimize the pilot-scale design for the proposal.
- Site-specific characterization and modeling data made available to the prequalified candidates through the TechCon web site is needed by vendors for successful proposals.

# SECTION 6

# Post-Forum Follow-up

***A review of prequalification submittals from vendors will be conducted in mid to late January.***

***An RFP will be issued in Marcy 2001.***

***The TechCon web site will be used to facilitate the dissemination of all information in support of the RFP.***

***A contract for the deployment of the pilot-scale (Phase I) system is scheduled to be awarded in May.***

A meeting was held between the Portsmouth project team and TAG to:

- Discuss the outcome of the forum
- Prepare for reviewing vendor prequalification submittals to Bechtel Jacobs following the 1/12/01 deadline
- Prepare for issuance of the RFP by identifying technical support to review the technical specifications and scope of work to be issued by Bechtel Jacobs procurement.

The Portsmouth project team and the TAG reviewed the key issues identified by the participants, many of which focused on available groundwater and soil data, groundwater modeling data, and the need for additional treatability testing. The TAG concluded that site data sources would be assessed and made available to the prequalified candidates. In addition, the TAG established a process that would allow prequalified vendors to obtain a soil sample and conduct treatability testing provided specific provisions were met. The treatability testing will not impact the current schedule for issuance of the RFP.

As a result of this post-forum meeting the following actions will occur during the second and third quarters of FY 2001:

- Vendor prequalification submittals will be reviewed in late January.
- An RFP will be issued in March 2001 to vendors who prequalified through the Bechtel Jacobs web site.
- Portsmouth will identify all data sources and make them available to prequalified vendors. The TechCon web site will facilitate dissemination of this information.
- Portsmouth will provide prequalified vendors an actual core sample from the aquifer and send it to a designated NRC-licensed laboratory for preliminary treatability testing.
- Portsmouth and the TAG will make available to vendors data files for the FRAC3DVS v3.1 Groundwater Model and the Numerical Groundwater Flow and Transport Model.
- The TechCon web site will facilitate dissemination of information in support of the RFP.
- A contract for deployment of the pilot-scale (Phase I) system is scheduled to be awarded in May.

# Key Organizations

**Department of Energy**
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